



iSys – Intelligent Systems



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1. Introduction.

@Metering is an integrated system that allows remote meter reading:

- electric energy
- gas
- water
- warm water
- flow of liquids, gases, liquid fuels
- radiation dosimeters
- other devices with pulse output where the number of pulses is proportional to the measurement of a given physical value

It works by counting pulses from meters equipped with a pulse output on the basis of summation. The **@Metering** controller allows you to count pulses from up to 4 counting inputs, and store them in non-volatile EEPROM memory. The system does not interfere with existing meters of energy/water/gas/etc. . It requires connecting the counting input to external pulse generator connectors. The results are periodically sent to the **@City cloud** for billing or measuring purposes using available communication media.

@Metering is part of @City the Smart City system from iSys - Intelligent Systems.

The data is sent to the server of the **@City** system - to the mini-cloud, dedicated to the "operator/supplier", commune or region.

The main communication type of @City devices is GSM transmission: NB-IoT (T-Mobile / Deutsche Telecom), LTE-M1 (Orange), or SMS/2G/3G/4G (all GSM operators). Alternatively, communication can be accomplished using @City devices with a built-in LoRaWAN long range radio transmission modem that works in the open (public) 868MHz (EU) and 902/915MHz band for other continents. For LoRaWAN devices, it is necessary to use a hub (gateway) and network/application server (NS/AS).

The energy consumption of the devices depends on the communication technology used: the lowest has LoRaWAN and then GSM technologies are listed in turn. For GSM technology, it should be taken into account that in the absence of services or too weak signal, low-energy technologies: NB-IoT and CATM1 will switch to 2G (high-energy) technologies, which results in much faster battery consumption.

In building applications, the @Metering system can use other communication methods (available in the eHouse

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system) wired (Ethernet, RS-485 / RS-422, CAN) and wireless (WiFi), which in some situations can allow a significant reduction in system costs. For communication methods from the eHouse system, an additional hub/server/gateway to the @City cloud is required, but we do not pay subscription fees for each device.

In critical situations it is possible to duplicate communication media, e.g. GSM + LoRaWAN + CAN + RS-422/485.

@Metering - LoRaWAN controllers

The basic communication interface is LoRaWAN (1.0.2). Optionally, it can have wireless short-range interfaces and wired communication interfaces:

- BlueTooth (4.2)/BLE
- NFC
- Infrared
- CAN
- UART/RS-485
- SPI/I2C (for installing additional sensors)

Additional controller equipment is discussed in the document: "IoT-CloT-devs"

@Metering - GSM controllers

The basic communication interface of the system can be one of the following interfaces:

- GSM (2G) / NB-IoT / LTE-M1
- GSM (2G) / 3G
- GSM (2G) / 4G (LTE)

Optionally, it can be equipped with:

- GPS / GNSS
- CAN
- UART
- SPI / I2C (for installing additional sensors)

Additional controller equipment is discussed in the document: "IoT-CloT-devs"

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The **@City portal** allows visualization on the map, bar charts as well as direct sending of emergency messages to intervention groups (e.g. SMS / eMail / USSD). It is possible to create dedicated algorithms (BIM) - "modeling information" for processing and performing implemented actions.

It is also possible to integrate external systems through direct access to the @City database (cloud to cloud).

2. Capabilities and maximum functionality of the @Metering system

@Metering devices can be powered from:

- external power supply
- Battery
- external power supply with voltage backup (UPS + battery)
- energy harvesting (e.g. photovoltaics, magnetic field energy near high voltage cables) + energy storage battery

@Metering devices can simultaneously implement remote and autonomous:

- LED lighting/Power supply control (Dimming) (*)
- control of electrical devices (on / off) (*)
- turn off the media (via connected solenoid valves, relays, etc.) in case of unpaid charges (*)
- perform additional measuring functions from optional sensors:
- temperature, pressure, humidity, thunderstorms / lightning, flooding
- particulate matter, dust (*)
- air quality, gas, smoke, volatile organic compounds
- current, voltage, resistance, capacity
- carry out additional measurements constituting device protection (predictive maintenance) measurement in 3 axes (X, Y, Z):
 - Accelerometer (acceleration, vibration)

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- Inclinometer (displacement)
- gyroscope (rotation angle, heel)
- Magnetometer (magnetic field) e.g. checking the magnetization tests of the water / energy / gas meter.

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- Perform alarm and anti-tamper functions
- Protective contacts (tamper) against disassembly, tampering with the device.
- GPS for geo-positioning and device location

(*) - the use of the remote control function significantly increases the consumption of electricity and may require the use of an external power supply (from the power grid). Media blocking may require the use of additional external components and require interference with the installation (relay, solenoid valve, etc.)

- the ability to send measurements to the cloud every 1 min. 24h/day.
- the ability to receive / execute commands after sending the current status of the device
- Basic GSM wireless transmission: 2G, 3G, LTE, SMS, USSD (for any operator), LTE-M1 * (Orange), NB-IoT
 ** (T-Mobile) requires the SIM card or MIM of the selected operator and subscription fees for data transmission or telemetry tariffs.
- alternative wireless LoraWAN, WiFi, RF transmission no additional subscription fees required
- GPS position measurement after measurements (Longitude and latitude, altitude, speed, direction)
- self-positioning on maps with current measurement results
- independent protection and monitoring of measuring devices (against theft and devastation alarm)
- *, ** depends on the availability of the operator's service in the current location

3. @Metering Device Work

The device counts pulses from 4 meter inputs in a continuous mode, and stores them in the non-volatile memory of the controller. Current meter readings and controller status are sent to the @City cloud at programmed time intervals (1min - 1day).

The controller can additionally perform other measurements periodically (discussed earlier). If the measurement value does not fall within the range (Min, Max), the entire controller status is sent to the cloud (regardless of the programmed time interval). Sending this information is also an alarm protection device for:

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- attempts to dismantle
- devastation
- sabotage
- location changes
- e.t.c.

This allows the intervention team to be sent to the scene of the incident and caught the offender "in the act".

The device also has the option of receiving control commands that are read from the **@City cloud** after sending the controller status. This allows you to perform manual operations and automatic commands. They can be any controller commands (e.g. switching off solenoid valve output, relay output, etc.).

3. Communication

Transmission of measurement data is carried out through one communication interface *:

GSM (2G..4G, USSD, SMS, LTE-M1 {CAT-M1}, NB-IoT) - requires GSM operator subscription fees and coverage coverage for the selected service. The maximum range is a few kilometers from GSM BTS in the open area.

WiFi 2.4GHz b/g/n - requires access to a WiFi network with internet access. It does not contain GPS and does not have automatic geolocation (only the stationary variant with a predefined GPS position). It can also be used as intervention equipment for measuring pollution on site. Maximum range up to approx. 100m to WiFi Router in the open area.

LORAWAN (868MHz/EU and 902,915MHz/others) - long range radio communication in the public band. Due to the open and free nature of the frequency band, there is a risk of interference and jamming of the device by other devices. Requires the installation of a minimum of one LORaWAN+Internet gateway - ensuring coverage of the entire area (e.g. high chimneys or GSM masts) or buildings/offices (with external antennas). Maximum range of about 10-15km in a low urban area can be reached. LORaWAN variant does not include GPS.

* - depending on the type of @Metering controller selected

4. Dedicated @City platform (cloud)

IoT, IIoT, CioT @City platform was described at "@City" document.

5. Equipment Variants

The devices can be in many hardware variants, both in terms of equipment options and housings (which gives several dozens combinations). In addition, when measuring humidity, particulate matter, the device must be in contact with flowing outside air, which imposes certain requirements on the housing design.

Therefore, the enclosures can be individually ordered depending on the needs or the system may be available in OEM form (PCBs to be built into own enclosures/devices/counters).

5.1. Options for electronics

- Application of the particulate sensor 2.5 / 10um
- Use of an environmental sensor (temperature, humidity, pressure, air quality)
- The use of lighting control elements
- Different power variants (85-230V, 85-230V + UPS, battery, energy harvesting)
- Any choice of additional sensors, tampering, failure prediction (for the whole batch of controllers for the partner).

5.2. Mounting range

- Stationary equipment
- mobile devices

5.3. Covers:

- dedicated metal stationary/mobile enclosures selected color, graphic design, printing/stickers, method of attachment
- adapted plastic housings
- dedicated plastic enclosures

The casing depends on the size of the battery, the antenna and application used and the requirements of the measuring sensors.

6. Usage Information

The laser air pollution sensor used may be damaged if the concentration of dust, tar is too high, or direct water contact and in this case it is excluded from the warranty of the system. It can be purchased separately as a spare part. The warranty excludes acts of vandalism, sabotage on the device (attempts to pour, freeze, smoke, mechanical damage, lightning, etc.).

7. @Metering Device Electrical Parameters

Electrical parameters of @Metering controllers are located at "IoT-CIoT-devs-en" documentation

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